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but this does not lessen my regret at having unintentionally misrepresented the views of the distinguished leader of cell-research for whose splendid discoveries every investigator must feel such admiration.

EDMUND B. WILSON.

COLUMBIA UNIVERSITY,
NEW YORK, December 19, 1896.

THE VELOCITY OF A FLIGHT OF DUCKS OBTAINED BY TRIANGULATION.

MEASUREMENTS of the heights and the velocities of clouds are now being made at the Blue Hill Meteorological Observatory by Mr. Rotch as a part of an international scheme for such work. The measurements are made with specially constructed theodolites in which a large conical tube, with crossed wires at one end and an eye-piece at the other, replaces the ordinary telescope.

On the morning of December 8th, while Mr. S. P. Fergusson and I were engaged in measuring clouds, a flock of ducks passed across our base-line, which is 2590.3 metres (8496 feet) in length. We succeeded in getting one simultaneous set of measurements on the apex of the flock from which its height was calculated, and one or two independent subsequent observations, from which the velocity was calculated. The height was 958 feet above the lower station, which is situated in the valley of the Neponset river, above which the ducks were flying.

The velocity of flight calculated from this measurement of height, and from the angular velocity measured at one end of the base-line is 47.9 miles in an hour, and from the angular measurements made at the other end of the base-line is 47.7 miles an hour, making a mean of 47.8 miles. The wind was very light, having a velocity of only two miles an hour according to the automatic record made at Blue Hill Observatory, 615 feet above the valley station. The direction of the wind was from the north, and the ducks were flying from the northeast. These observations were not in our program, but they may prove of interest to ornithologists and students of aeronautics.

H. HELM CLAYTON.

BLUE HILL METEOROLOGICAL OBSERVATORY,
READVILLE, MASS., December 21, 1896.

A TEST ON DIVERSITY OF OPINION.

TO THE EDITOR OF SCIENCE: It is always interesting to test diversity of opinion, particularly on questions of exact reasoning. It is quite difficult to obtain a test which is at once significant and general. I should be very much indebted to those of your readers who would be willing to send me answers to the following request.

Here is a piece of reasoning which is certainly capable of arousing criticism:

Granted that A is B, to prove that B is A.

B (like everything else) is either A or not A.

If B is not A, then by our first premise, we have the syllogism:

A is B;

B is not A;

∴ A is not A; which is absurd.

Therefore, B is A.

Is this reasoning correct or is it not? If regarded as correct, my request is to have the reasons for its correctness given as explicitly as possible. If it is regarded as incorrect, I wish in the same way a very explicit statement of the nature of the error. Answers are requested from all who are interested in the matter. I am particularly desirous of receiving replies from those whose interest in thought is a philosophical one, as well as from those who are more specially devoted to scientific pursuits.

JOSEPH JASTROW.

UNIVERSITY OF WISCONSIN,
MADISON, WIS., December 5, 1896.

SCIENTIFIC LITERATURE.

A Geographical History of Mammals. R. LYDEKKER. Cambridge Geographical Series. Cambridge (England) University Press. 8° pp. 400, col. map and figures in text. September, 1896. For sale by The Macmillan Company, 66 Fifth Ave., New York City. Price, \$2.60.

The subject of the geographic distribution of animals is not one to be mastered in a few weeks or months, and many are the pitfalls that lie in wait for the author who seeks to illumine its difficult problems. It is rare, indeed, that a writer in his first essay on this theme suddenly leaps to a position of authority, yet this is precisely what Mr. Lydekker has done. He has approached the subject from a new direction—

that of the extinct ancestors of existing faunas—and has brought together a multitude of significant facts which no one but a paleontologist could safely venture to attack. The result is a volume which, in spite of the imperfections and errors incident to so great an undertaking, will rank among the standard works on Geographic Distribution for many years to come.

The influence of man on the dispersion of animals is excellently told. Mr. Lydekker says: "Probably ever since man has existed in any numbers on the globe he has been exerting a more or less strongly-marked influence on the distribution of animals, either by destroying them or by conveying them to countries or districts which are not their natural home. By the involuntary aid of man the common rat and mouse, which belong to a genus unknown in the New World, have been conveyed to every country in the globe; while the rabbit has been carried to the antipodes, where it has flourished and increased in an unprecedented manner. Cattle and horses have been introduced into South America, Australia and other countries where they were naturally unknown, and by their rapid increase have shown that the absence of particular animals from particular districts is not necessarily due to their being unsuited to live there, but rather to the fact that they have been unable to find their way thither. The fallow-deer, again, has been imported from its Mediterranean home into England and other countries of northern Europe; while goats and pigs have been carried to a number of oceanic islands, where they have done irreparable harm in exterminating the native fauna and flora." Sheep also might have been mentioned among the potent destroyers of native floras. "In all these instances," Mr. Lydekker continues, "the fact of the introduction has always been more or less clearly known, and therefore no difficulty arises as to what are native and what are introduced forms. Very different, however, is the case with the Islands of the Malay Archipelago, where the natives, who have a wonderful facility for taming animals, have carried a species peculiar to one district or island to localities where it is quite unknown as a native; and in consequence of this transportation and acclimatisation it is probable that several mammals

have been given a habitat to which they have not the most remote right. To the Malays is due the introduction of the small civet known as the *rasse* into Madagascar. Whether the dingo, or native dog of Australia, was introduced at an exceedingly remote era by the original colonizers of that island, or whether it is truly indigenous, is a question that will probably never be decisively answered. It is likewise quite impossible to say what part man may have played in the extermination of the large mammals that inhabited Europe about the close of the glacial period, but it seems quite probable that he may have had a considerable share in their destruction. Be this as it may, the domestication of certain mammals, has undoubtedly had the effect of destroying the wild race, as is remarkably exemplified by the two existing species of camel, of neither of which do we know the original habitat." (pp. 16-17.)

In treating of barriers to dispersion Mr. Lydekker revives the fallacy that "high mountain ranges form an effectual barrier to the migration of mammals," but he cites no examples. It is true that in many instances, as in the Himalaya, mammals inhabiting the lands on opposite sides of the mountains are widely different. But this is due to a radical difference in the climates or physical features of the countries themselves, and not to the presence of the intervening mountains. Does any one know of the existence of a mountain range in the whole world which is continuously high enough and long enough to keep mammals from crossing it or passing around it if the country on both sides is suitable to their needs? Mountains are barriers to distribution only so far as their own mass is concerned.

While expressing his general adherence to the view that after mechanical barriers, such as oceans, temperature is the chief factor in fixing the limits beyond which species and genera do not pass, he cites as exceptions the time-worn cases of the puma and tiger, using these names in the sense of species. He says: "There are several species, more especially among the carnivorous mammals, which seem quite independent of both station and temperature, the New World puma ranging from Patagonia to Canada, while the tiger inhabits alike the burning jun-

gles of India and Burma, and the Arctic tundras of Siberia." It may be poetic license, but hardly scientific truth, to speak of the tiger as an inhabitant of 'Arctic tundras.' And Mr. Lydekker must be aware that the northern tiger differs so markedly from the southern that it is regarded by some naturalists as a distinct species and has received a distinctive name. Our American puma also is a composite beast, differing widely in different parts of its range.

Other cases of the same sort that have been often cited are those of the wolf and ermine weasel. In discussing this subject five years ago I said: "With the possible exception of the gray wolf, not a single species of mammal ranges throughout the Sonoran and Boreal Zones, though a number are common to the Upper Sonoran and Lower Boreal (Canadian); and in the case of the wolf it is almost certain that comparison of specimens will show the animal of the southern United States and Mexico to be perfectly distinct from that of Arctic America. The ermine is another species of phenomenal though less extensive range, if it is really true that the weasel inhabiting the shores and islands of the Polar Sea is specifically identical with that found in the more elevated parts of the Southern States—an assumption I cannot for a moment entertain."*

Since this was written it has been found that the northern and southern wolves are very different, and that the weasels inhabiting North America from the Arctic barren grounds to Mexico belong to no less than five different species, each characteristic of a particular climatic belt!

That Mr. Lydekker is a 'lumper' of species is well known, and is exemplified by his statement that in North America we have only a single species of porcupine (*Erethizon*) and only one of little spotted skunk (*Spilogale*)! The way he unites European and American mammals has been pointed out in this JOURNAL in reviews of his earlier works.† In the present volume he maintains his reputation in this direction, stating or implying that Eurasian and American wolverines, martens, wolves, foxes,

*Proc. Biol. Soc. Washington, VII., 48, April, 1892.

†See SCIENCE, April 5, 1895, pp. 387-389; July 5, 1895, pp. 18-21.

bears, lynxes, moose, reindeer and sheep are not specifically separable. With respect to the sheep he says: "The Kamschatkan wild sheep is so closely related to one race of the big-horn, or Rocky Mountain sheep that it is very questionable whether the two are really entitled to specific distinction." If Mr. Lydekker will take the trouble to glance at the skulls of these two animals, or even at the rather crude figures published by Guillemard in the Proceedings of the Zoological Society of London for 1885 (pp. 676-677), I do not think his faith in their distinctness will ever again be shaken.

Of the lesson to be learned from cases of discontinuous distribution, Mr. Lydekker states: "Examples of 'discontinuous distribution' among genera are of the very highest import to the science, since they clearly indicate that some of the lands lying between its present disconnected distributional areas must have formerly been the habitat of the genus, and thus enable important conclusions to be drawn as to the former land connections between such areas." But at the end of the book he implies his belief in the dual origin of both species and genera. He says: "The suggestion that *Equus* has thus been independently evolved in the two areas has been already mentioned, and this idea receives support from some very remarkable observations recently made on the invertebrates inhabiting certain European and North American caves * * * if animals which appear to belong to one and the same species can be proved to have had a dual origin in the one case, it can scarcely be considered impossible that similar instances may occur in the other. And if such dual origins exist among species, there is surely no reason why they should not occasionally occur in the case of genera. It would, therefore, seem by no means improbable that the species of the genus *Equus*, which inhabited the eastern and western halves of the northern hemisphere during the close of the Tertiary period, may have been evolved from the closely allied but separate ancestral equine stocks."

Respecting the geographic origin of types, the author holds the extreme view that "at least a very large proportion of the animals that have populated the globe in the later geological

epochs originated high up in the northern hemisphere, if not, indeed, in the neighborhood of the pole itself."

In some instances Mr. Lydekker calls particular attention to the widely different climatic conditions prevailing in Tertiary times from those of the same areas in our times, with consequent dissimilarities in past and present faunas; in other cases he assumes that the boundaries of existing faunas coincide essentially with those of the antecedent fossil faunas of the same area. Thus while explaining the great differences in the past and present life of the Arctic region on the ground of changes of climate, he would have us believe that the Sonoran region has maintained essentially its present boundaries since the days when it was inhabited by the remarkable extinct mammals known as Creodont Carnivora, Oreodont Ungulates, Protoceras, Camels, Titanotheriums, Coryphodons and others, all of which he regards as of Sonoran origin. While of much interest to know what types originated in this geographic area, does anyone imagine that its climate, when these extraordinary animals lived there, was the same as to-day?

But all this is preliminary. Coming to the real subject of the book Mr. Lydekker parcels off the globe into the following primary and secondary divisions:

- I. Notogæic Realm.—1. Australian Region.
2. Polynesian Region.
3. Hawaiian Region.
4. Austro-Malayan Region.
- II. Neogæic Realm.—Neotropical Region.
- III. Arctogæic Realm.—1. Malagasy Region.
2. Ethiopian Region.
3. Oriental Region.
4. Holarctic Region.
5. Sonoran Region.

To discuss this scheme with the fullness its importance deserves would require far too much space for the limits of the present review. The primary regions, or 'realms,' may be passed without comment, inasmuch as few writers agree on their numbers or boundaries; and little will be said of the paleontological side of the book or of the facts of present distribution outside of the Americas.

Mr. Lydekker accords to South America the

high distinction of primary rank, making it one of the three great 'realms' into which he divides the whole world. But he fails to see in its diversified faunas more than a single division of secondary rank—the 'Neotropical region'—whose boundaries he conceives to be coincident with those of the 'Neogæic realm;' and it is not until we come to divisions of the third rank, or 'sub-regions,' that he finds it necessary to take into account the widely different faunas that characterize the tropical forests, the grassy pampas and the lofty Andes. This seems scant justice, particularly by contrast with North America, where three full 'regions' are admitted. The number of Neotropical 'sub-regions' recognized is four, two of which—the Mexican and the Antillean—are northern outliers, leaving only two for the whole continent of South America. Of these, the first, or 'Brazilian sub-region,' "is essentially an area of dense tropical forests, locally interspersed with open pastures or 'campos.' The second is the Chilean sub-region, comprising Chili, Argentina proper, Uruguay, Patagonia and such portions of Peru and Bolivia as are not included in the preceding. It is chiefly an area of open plains and pampas, although including the high Andes."

If it could be assumed that Mr. Lydekker was unacquainted with the mammal faunas of South America, such a classification might be attributed to an imperfect knowledge of the facts, but his own enumeration of the characteristic genera and families of the different areas precludes this view and shows that the difficulty is mainly one of interpretation.

In speaking of the Mexican extension of the Tropical fauna, Mr. Lydekker makes the shocking statement: "Dr. Hart Merriam has proposed to unite Central America with the West Indies to form a separate zoological region—the Tropical—of equal rank with the Sonoran; but, however much may be urged in favor of this view, the multiplication of regions is much to be deprecated." It is hard to understand how any contortion of the imagination could give birth to such an overwhelming misconception. As a matter of fact, I simply remarked, after defining the Sonoran region, that the lowlands of Mexico, Central America and the West Indies belong to the American Tropical region—

without attempting any subdivision whatever—and using the term 'Tropical' in precisely the sense in which 'Neotropical' is commonly employed.

Another case of unintentional misrepresentation occurs on page 364 with reference to the peninsula of Lower California. At the end of a quotation from my Presidential Address on the Geographic Distribution of Life in North America he says: "The proposal to form a separate region for such an insignificant area as the southern extremity of California seems unnecessary, although its fauna may differ considerably from that of the typical Sonoran"—implying that I suggested its erection as a 'separate region,' whereas the rank I really gave it is the trivial one of a 'subdivision' of a 'zone.' I said: "The peninsula of Lower California is a subdivision of the arid Lower Sonoran Zone. Not a single genus of land mammal or bird is restricted to it and but two peculiar species of mammals have been described."*

In the same connection it might be mentioned that the only one of my papers on the life areas of North America quoted by Mr. Lydekker was published in the spring of 1892. Subsequent papers, containing certain modifications of the views expressed in 1892, together with much additional matter, are not referred to.

The part of the book which is probably of greatest importance is that which treats of the fossil vertebrates of South America. Mr. Lydekker has himself visited Argentina, and therefore should speak with authority. The paleontological discoveries of Ameghino in southern South America are of surpassing interest. Ameghino unearthed the fossil bones of a fauna which was not only previously unknown, but whose ancestry could not be clearly pointed to in any part of the world. The subsequent study of this fauna has developed some of the most interesting and far-reaching problems with which naturalists and geologists have had to grapple. These problems relate to the ancient land connections of South America and to the origin and lines of evolution of important groups of mammals and birds.

*Proc. Biol. Soc. Washington, VII., p. 29, April, 1892.

Our own distinguished paleontologist, Prof. W. B. Scott, in an address delivered a year ago before the Society of American Naturalists, stated that the earlier Miocene mammals of South America "are totally different from those of the northern land-masses, so much so that the correlation of horizons becomes a matter of extreme difficulty. The hoofed animals all belong to orders unknown in the north—*Toxodontia*, *Typotheria*, *Litopterna*—and the principal constituents of the fauna are immense numbers of *Edentates*, *Marsupials* and *Rodents*, with several platyrrhine monkeys. No artiodactyls, perissodactyls, proboscideans, Condylarthra or Amblypoda, neither Insectivora, Chiroptera, Carnivora or Creodonta are known. The Edentates are all of the specifically South American type, sloths, armadillos and the like. The Rodents also are very much like those which still characterize the region, though most of the genera are distinct; they are all Hystricomorpha, neither squirrels, marmots, beavers, rats or mice, hares or rabbits occurring among them." (SCIENCE, February 28, 1896, 308.)

The total absence of the early South American types from the rich deposits of vertebrate fossils in the United States, and the corresponding absence of North American types from all but the later fossil beds of South America, prove clearly, as Mr. Lydekker says, that "there must have been a barrier between North and South America during the Oligocene and a portion or the whole of the Miocene." Scott has already told us that "in the Pliocene (Monte Hermoso) appear the first traces of the union with North America, in the presence of mastodons, horses, tapirs, deer, llamas and true carnivores, and from that time till far into the Pleistocene the intermigrations between the two continents kept up until a large number of common types had been established." Lydekker, speaking of the same event, says: "The presence of a glyptodont in the Nebraska stage of the Loup-Fork group in North America, and of northern forms in the Monte Hermoso horizon of South America, marks, then, the first comingling of the original faunas of the two halves of the New World. For the first time in the history of the southern continent this connec-

tion allowed of the immigration from the north of the true Carnivora, such as the existing cats (*Felis*), the extinct sabre-toothed tigers (*Machærodus*), dogs and foxes (*Canidæ*), bears (*Ursus* and *Arctotherium*), raccoons (*Procyonidæ*), skunks and their allies (*Mustelidæ*), together with various ungulates belonging to suborders previously unknown in the realm. These latter include the guanaco and vicuña (*Lama*), of which ancestral forms are abundant in the North American Tertiaries, New World deer (*Cariacus*), horses (*Equidæ*) of various genera, tapirs (*Tapiridæ*), peccaries (*Dicotylidæ*) and mastodons. Among the rodents, squirrels, the various genera of *Muridæ* and the hares, likewise at this epoch made their first appearance on the scene. Opossums also at this time effected an entrance into the land which has now become their chief home." (Pp. 119-120.)

Having arrived at the conclusion that the Pliocene and present mammal faunas of South America came from North America, and that the earlier faunas could not have been derived from the same source, Mr. Lydekker seeks to account for the origin of the latter. This, he freely admits, "is a difficult and perplexing subject which it is scarcely possible to explain fully in the present imperfect state of paleontological knowledge." Still, he agrees with Scott, Neumyr and others in the belief that the evidence points strongly to an early land connection with Africa and also with Australia. In the case of certain Patagonian marsupials he finds it difficult to come to any conclusion other than that their ancestors "reached the country from Australia, either by way of the Antarctic continent or by a land bridge in a more northern part of the Pacific." Continuing, he observes: "If this be correct, and likewise the supposition that the opossums originated from the ancestral stock in southeastern Asia, it will be evident that *Didelphys* and *Cænolestes* met in South America after their ancestors had travelled half around the world in opposite hemispheres."

Mr. Lydekker is evidently disturbed by his inability to define to his own satisfaction the Mediterranean region—the analogue of our Sonoran. He speaks of it again and again, but not always in the same way. Thus is one place

(p. 310) he says: "Could a Mediterranean region be satisfactorily defined, the homogeneity of the mammalian Holarctic fauna would be still more apparent; but this, from the great mingling of northern and southern types which has taken place in the Old World, is, I think, impracticable." Again: "The Mediterranean or Tyrrhenian sub-region has strong claims to be regarded as representing a region by itself" (357). I have no doubt that sooner or later some enterprising naturalist will make a detailed study of this region, tabulate its distinctive genera and define its tortuous boundaries.

While it is not the purpose of the present review to criticise technical points in classification, one cannot help wondering on what characters the statement is based that the sewellels (*Aplodontia*) are 'closely allied to the squirrels.' On the other hand, it is pleasing to note that the aard-varks and pangolins are separated from the Edentates proper and given independent ordinal rank, under the name *Effodientia*. The lemurs are retained among the Primates—the usual and conservative course. Prof. Hubrecht has recently shown that the embryology and placentation of the Lemuroidea indicate that these animals are entitled to rank as an independent order, and that *Tarsius* is not a Lemuroid at all, but the earliest known Primate. He finds that the fossil genus *Anaptomorphus* of Cope is intermediate between *Tarsius* and the higher Primates, while *Tarsius* itself looks back to an ancestry suggesting the genus *Erinaceus* of the heterogeneous order Insectivora. Prof. Wilhelm Leche, from a study of the teeth, arrives at somewhat different conclusions.

The interesting and highly important subject of the geographic 'centers of evolution' is dismissed with a single page, where it is handled gingerly and in general terms only. In view of the standpoint from which the book is written—that of the paleontologist—it seems as if a chapter had been omitted—a chapter on the centers of origin, in time and space, of the different groups of mammals. Much information of this kind is scattered through the book, but it would be exceedingly convenient to have it epitomized by groups.

Evidences of haste in the preparation of Mr. Lydekker's book crop out here and there, par-

ticularly in the case of contradictory statements on different pages. For instance, on page 87 it is said that the Sonoran family *Geomyidae* has only two genera (inferentially *Geomys* and *Thomomys*), while on the same page the genus *Heteromys* is added, and on a later page (366-7) no less than seven genera are enumerated as included within the family! Again, on page 342 it is stated that no member of the family *Geomyidae* is found within the limits of the Holarctic region, while on page 366 we are told that the genus *Thomomys* of this family 'penetrates into the Canadian sub-region of the Holarctic.'

Lack of personal familiarity with the geographic distribution of living mammals in North America, and carelessness in examining current literature, have led to a number of additional errors. For instance, the genus *Spermophilus* is said to be restricted to the 'Holarctic' (= Boreal circumpolar) region, whereas we have one Tropical and at least a dozen Sonoran species, and two well marked Sonoran sub-genera. Again, the lynxes are said to be 'absolutely confined' to the Holarctic, while in the United States they range throughout the Sonoran and south into Mexico. *Zapus* also is said to be 'solely Holarctic,' although it is common as far south as the city of Washington. In the case of the rabbits it is stated that the greater number of species are Holarctic. In America the contrary is true, the greater number being Austral or Sonoran. We are told that *Notiosorex*, a genus of shrews, ranges south to Central America, but it is unknown from any point south of Mazatlan, in Mexico. Similarly the raccoons (genus *Procyon*) are said to occur 'over most parts of North and South America,' but in North America they are absent from the northern half of the continent.

The book is well printed and some of the illustrations are good; others, as, for instance, that of the tree-shrew (Fig. 61), look as if they might have been exhumed from the tombs of the ancients.

The work deserves a critical review from the paleontological side by some one competent to speak from the American standpoint. Then a revised and corrected edition should be brought out, for in spite of its imperfections, the book is probably the most useful contribution ever

made, at least in the English language, to the subject of the distribution of the Mammalia, living and extinct. C. HART MERRIAM.

The Elements of Electrochemistry. By MAX LE BLANC. Translated by W. R. WHITNEY. Pp. x+284. New York, The Macmillan Company. 1896. Price, \$1.50.

This volume is the English version of Le Blanc's *Lehrbuch der Elektrochemie*, which was published at Leipzig in the early part of this year.

The original met with a cordial reception, and this translation certainly deserves a warm welcome at the hands of those who are interested in the subject of which this book treats, but who are unable to consult it in the language in which it was written.

It has been the author's intention, averred in his preface, to 'write as clearly and simply as possible.' In this he has certainly succeeded.

The opening chapter brings an introduction to the fundamental principles of energy in general, and electricity in particular, which is most logically and lucidly written.

Next comes a chapter containing a brief but well balanced history of the development of electrochemistry up to the present time, and then follow able presentations of the Arrhenius theory of dissociation, the migration of the ions, the conductivity of electrolytes, electromotive force; a discussion of galvanic elements and accumulators forms the concluding chapter.

A careful perusal of this treatise will certainly place its reader in possession of a clear and comprehensive view of the present state of this important subject—electrochemistry.

Comparison with the original shows the translation to be well done and fluent; the translator having wisely avoided too close an adherence to the author's style, which at times is a little ponderous.

Omission, in the English book, of the plus and minus signs, used by Le Blanc to specify the two kinds of ions, is to be regretted. On the other hand, valuable features introduced by the translator are the subject-index and the list of authors' names.

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